A New Species of *Streptostachys* (Poaceae: Paniceae) from Brazil

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ABSTRACT. A new species of *Streptostachys*, *S. rigidifolia*, from the Brazilian state of Maranhão is described, illustrated, and compared with previously described species in the genus. Anatomical data on the leaf blade of the new species are also provided.

Upon examination of recent gatherings of Poaceae from Maranhão, Brazil, a new species of *Streptostachys* P. Beauvois was encountered, which is here described, illustrated, and compared with species previously included in the genus by Morrone & Zuloaga (1991).

Streptostachys rigidifolia Filgueiras, Morrone & Zuloaga, sp. nov. TYPE: Brazil. Maranhão: Loreto, BR-230, estrada para São Raimundo das Mangabeiras, ca. 22 km de São Raimundo, 6°56′S, 45°19′W, cerrado baixo com estrato graminoso aberto, 13 maio 1988, *L. B. Bianchetti, F. R. Ferreira & J. N. Silveira 634* (holotype, CEN; isotypes, B, BM, IBGE, K, MO, R, RB, SI, SP, UB, US). Figures 1–3.

Ab omnibus speciebus generis flosculo superiore glabro papillis compositis ornato differt. *Streptostachys ramosa* similis sed plantis 68–95 cm altis, inflorescentia racemosa vel subpaniculata 6–17 cm longa abunde differt.

Robust, stout, caespitose and short-rhizomatous perennial. *Culms* 68–95 cm tall, simple, bearing basal and cauline leaves; internodes cylindrical, hollow, glabrous; nodes swollen, shortly pilose with whitish hairs. *Sheaths* pilose, more so toward the base, or glabrous, striate, one margin hyaline, the other ciliate. *Ligules* a ciliate rim ca. 1 mm long, with hairs up to 7 mm long, behind the ligule at the base of the blade and on the upper margins of the sheaths. *Blades* lanceolate, 25–50 cm long, 5–8 mm wide, rigid, glabrous or with few scattered hairs, strongly striate, rounded at the base, the apex pungent, acuminate, the margins denticulate and/or ciliate. Peduncle cylindrical, scabrous, to 30 cm long. *Inflorescence* exserted, racemose or subpaniculate, 6–17 cm long, formed by 2–6 branches 9–11 cm long, all bearing unilateral spikelets along their entire length; main axis short, triquetrous, scabrous, terminating in a spikelet; spikelets solitary on the branches, the pedicels 1–3 mm long, swollen, partially adnate to the rachis of the branches. *Spikelets* narrowly ellipsoid, 5–8 mm long, shortly pilose, with thickened, conspicuous internodes between the glumes, and florets; upper glume and lower lemma subequal, conspicuously coriaceous. *Lower glume* ovate, 3–6 mm long, ⅓–⅔ the length of the spikelet, acute, 3(–5)-nerved, adaxial, slightly asymmetrical. *Upper glume* 5–6 mm long with a few short hairs throughout, 5-nerved, the nerves anastomosed toward the apex. *Lower floret* male; stamens 3, the anthers 3 mm long; lodicules 2, truncate, conduplicate, 0.5–0.8 mm long; lower lemma 5.5–6.5 mm long, 5-nerved, prominently pilose toward the apex; lower palea well developed, lanceolate, 4.2 mm long, 1.6 mm wide, hyaline, strongly 2-nerved. *Upper floret* narrowly ovoid, 4.5 mm long, 1.6 mm wide, indurate, pale, shiny, with regular compound papillae evenly distributed over the surface of the lemma and palea; lemma 5-nerved; styles 2, free from the base of the gynoecium; stigmas plumose, purple; stamens 3, with purple anthers; lodicules 2, conduplicate, 0.5–0.8 mm long. *Caryopsis* planoconvex, 3–3.5 mm long; hilum linear along the entire length of the caryopsis.

Streptostachys rigidifolia is known only from a single population in the municipality of Loreto, Maranhão, Brazil, in cerrado vegetation.

This species has been included in *Streptostachys* because of its inflorescence type, the thickening of the rachilla between the glumes and florets, the nervation of the glumes and lower lemma, and the linear hilum (Morrone & Zuloaga, 1991).

Streptostachys rigidifolia is unique in the genus because of its glabrous upper floret, with compound papillae over its entire surface. It can be further distinguished from *S. ramosa* and *S. macrantha* by the coriaceous upper glume and lower lemma; in *S. ramosa* and *S. macrantha* the upper glume and lower lemma are membranous; both species have a pilose upper floret with simple papillae over the

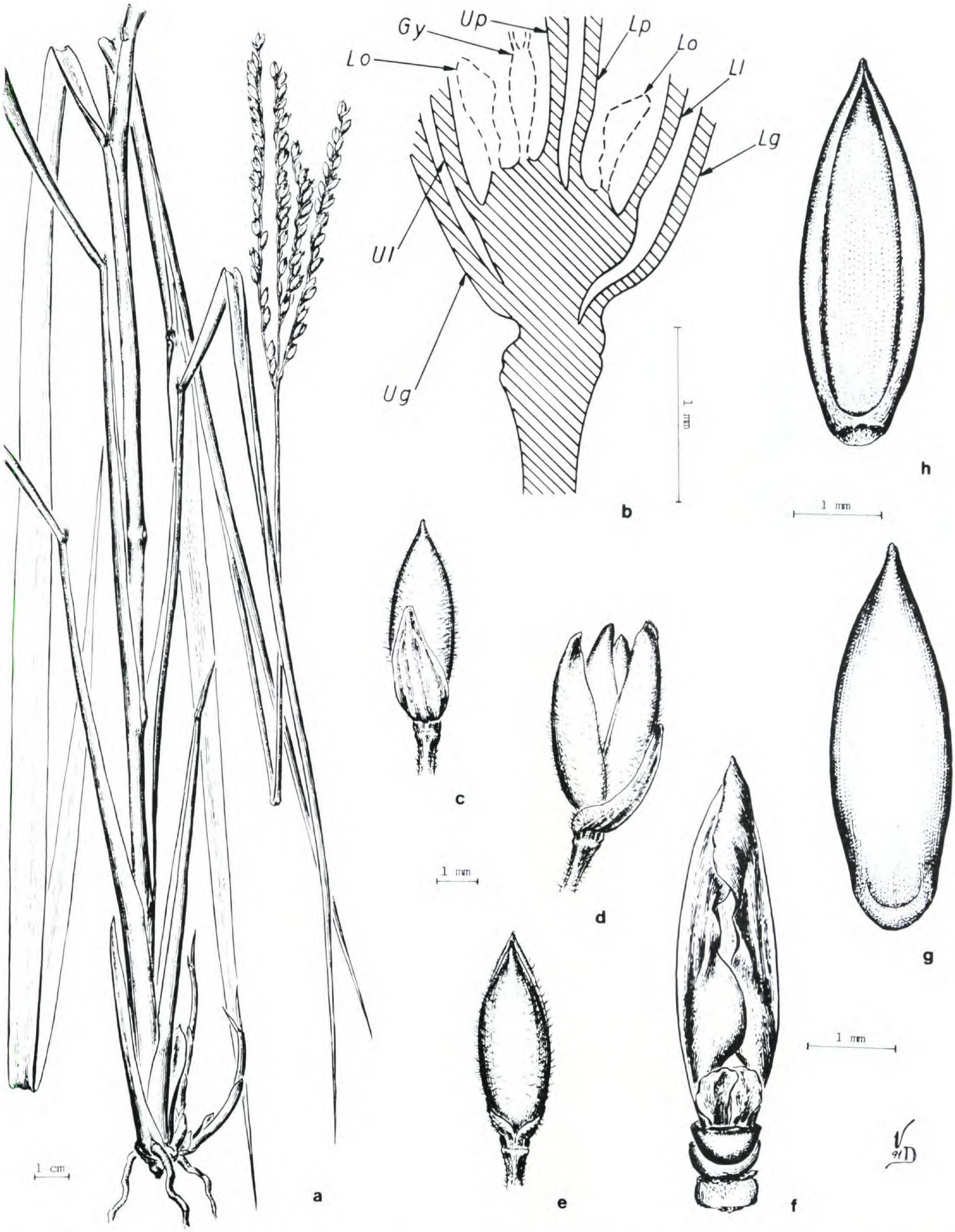

Figure 1. *Streptostachys rigidifolia* Filgueiras, Morrone & Zuloaga. —a. Habit. —b. Schematic longitudinal section of spikelet base, indicating conspicuous thickened internodes: Lg: lower glume; Ug: upper glume; Ll: lower lemma; Lp: lower palea; Ul: upper lemma; Up: upper palea; Lo: lodicules; Gy: gynoecium. —c. Spikelet, ventral view. —d. Spikelet, lateral view. —e. Spikelet, dorsal view. —f. Upper palea and lodicules. —g. Upper floret, dorsal view. —h. Upper floret, ventral view, lemma and palea. (Based on *Bianchetti et al. 634.*)

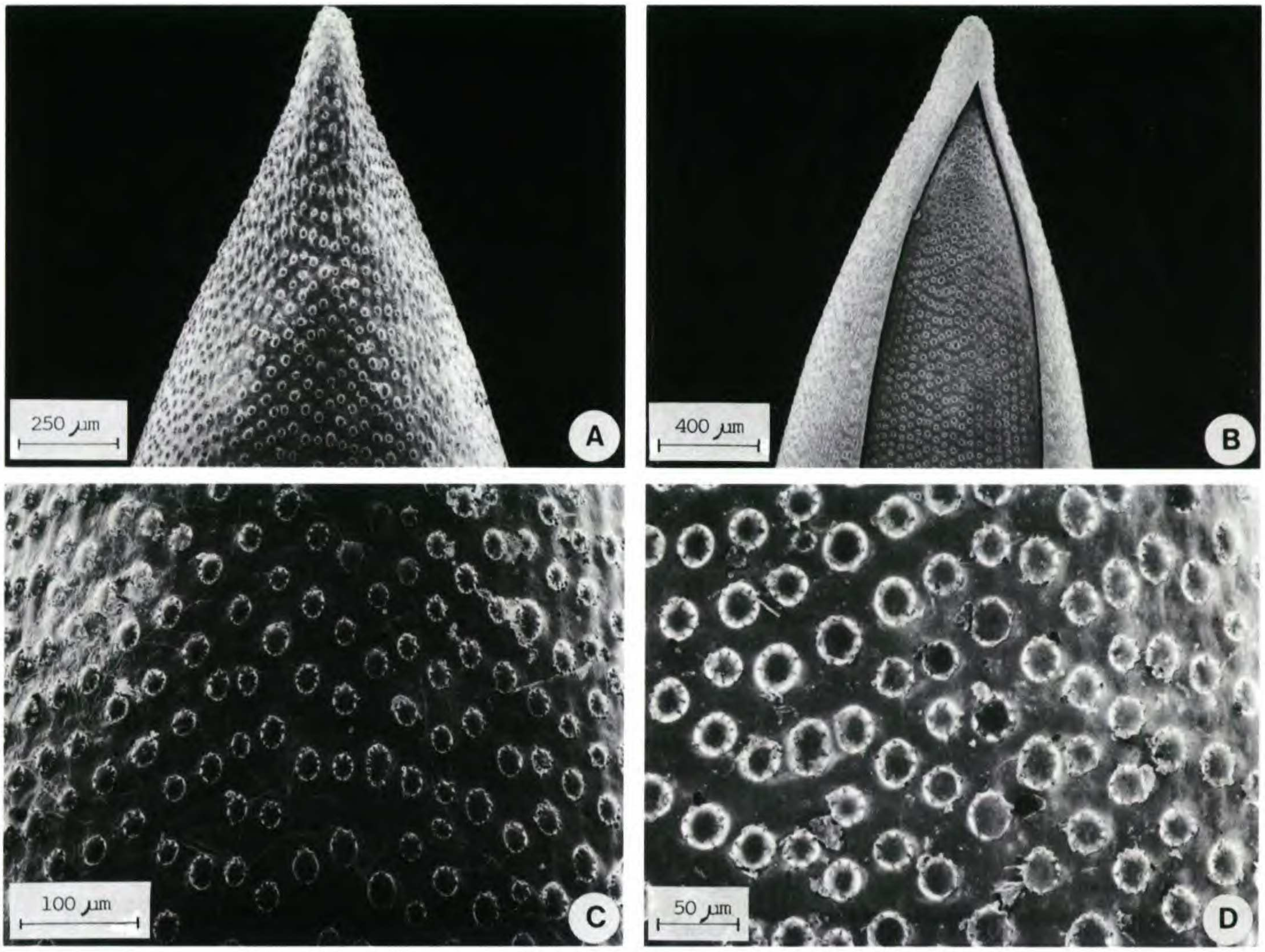

Figure 2. Scanning electron micrographs of the upper floret of *Streptostachys rigidifolia*. —A. Upper portion of lemma. —B. Upper portion of palea and lemma. —C. Detail of the surface of the upper lemma showing compound papillae. —D. Detail of the surface of the upper palea showing compound papillae. (Based on *Bianchetti et al. 634.*)

surface of lemma and palea. The plant height and inflorescence size and shape are further distinguishing characters: *S. macrantha* includes plants 30–70 cm tall, and inflorescences with whorled lower branches. *Streptostachys ramosa* includes plants 130–200 cm tall, inflorescences 30–45 cm long, with whorled lower branches. *Streptostachys asperifolia* differs from *S. rigidifolia* by the following features: presence of axillary inflorescences, spikelets 3.6–5.1 mm long, lower glume $\frac{2}{3}$–$\frac{4}{5}$ the length of the spikelet, absence of lower flower and blades cordate, amplexicaulous.

Paratypes. BRAZIL. **Maranhão:** Loreto, km 291.2 da BR-230, barranco íngreme de estrada a cerca de 22 km de São Raimundo, 20 março 1983, *J. F. M. Valls, G. Veiga & Silva 8432* (CEN, ICN, MEXU, VEN).

ANATOMY OF *STREPTOSTACHYS RIGIDIFOLIA*, FIGURE 3

The techniques used in the anatomical study follow Morrone & Zuloaga (1991), and the terminology follows Ellis (1976, 1979).

LEAF BLADE IN TRANSVERSE SECTION, FIGURE 3A, B

Outline: open, expanded, flat, two halves symmetrical on either side of median vascular bundle; leaf thickness 310–420 µm. *Ribs and furrows:* rounded adaxial ribs, associated with first- and second-order vascular bundles; the larger ribs alternated with the smaller ones; adjacent ribs separated by narrow furrows, penetrating up to $\frac{1}{3}$ the leaf thickness; abaxial ribs and furrows slightly undulating with no regular pattern associated with the vascular bundle. *Median vascular bundle:* midrib or keel not developed; median vascular bundle structurally indistinguishable from lateral first-order vascular bundles. *Vascular bundle arrangement:* 15 first-order vascular bundles, 10 second-order vascular bundles and 34–36 third-order vascular bundles in entire blade; 1 second-order vascular bundle and 2–3 third-order vascular bundles between consecutive first-order vascular bundles. First-order vascular bundles centrally located in the blade thickness, second- and third-order vascular bundles abaxially displaced. *Vascular bundle description:* first-

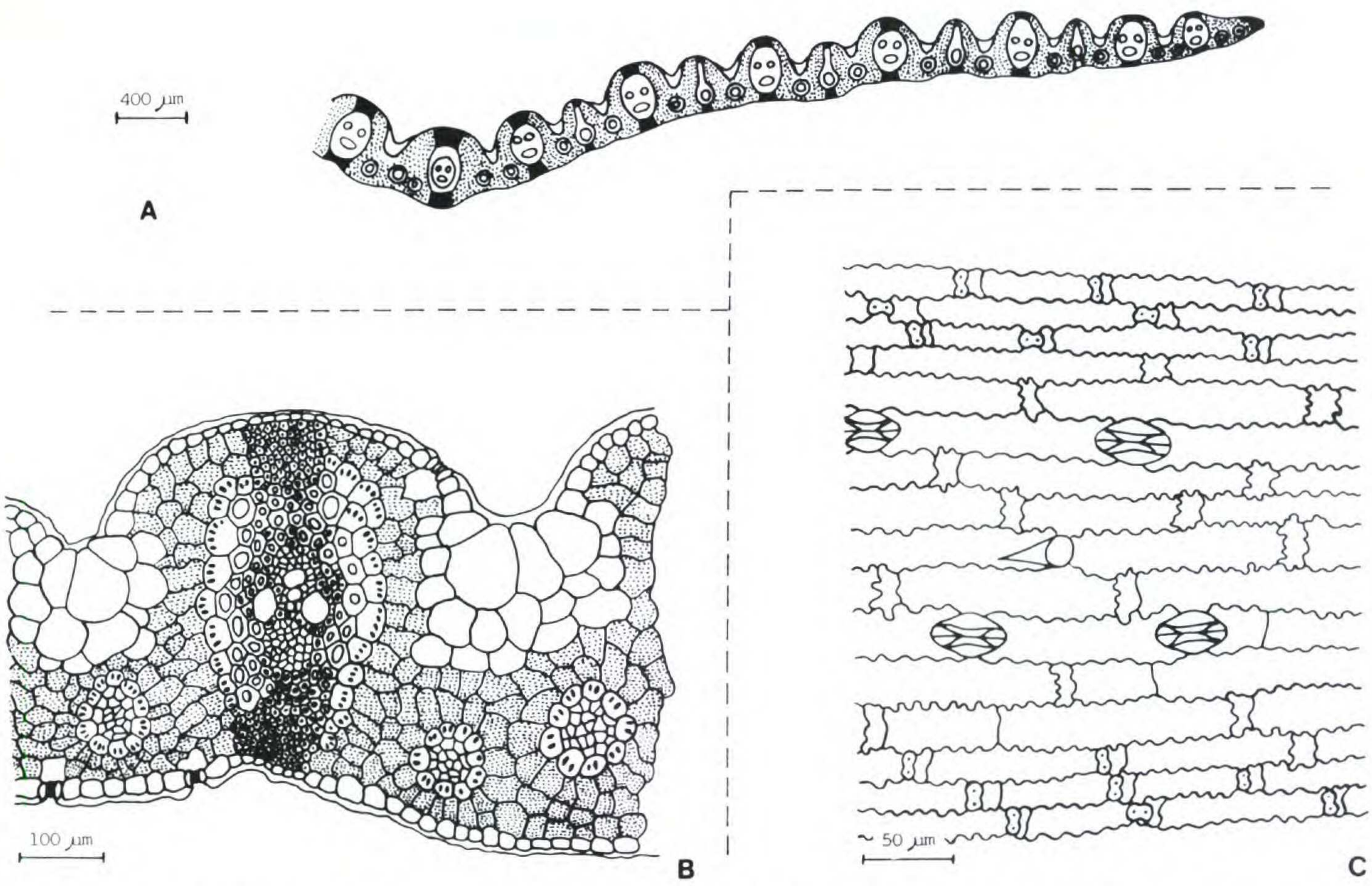

Figure 3. Leaf blade anatomy of *Streptostachys rigidifolia*. —A. Outline showing absence of a keel. —B. Transverse section detail showing first-, second-, and third-order vascular bundles, bulliform cells with associated colorless cells. —C. Abaxial epidermis showing costal and intercostal zones. (Based on *Bianchetti et al. 634.*)

order vascular bundle elliptical in outline; metaxylem vessel equal or bigger than the Kranz cells as seen in section, metaxylem vessels slightly angular in outline; sclerenchymatous cells present in 1–3 rows between the metaxylem vessels and Kranz cells, fibers lignified, lumen small; phloem tissue completely surrounded by thick-walled fibers. Second-order vascular bundle elliptical in outline with xylem and phloem tissue distinguishable. Third-order vascular bundle angular in outline with metaxylem and phloem tissue indistinguishable, located below the furrows. *Vascular bundle sheaths:* first-order vascular bundle surrounded by a single Kranz mestome sheath of 22–27 cells, with adaxial and abaxial interruption of sclerenchyma girders; second-order vascular bundles completely surrounded by a single Kranz mestome sheath, consisting of 12–14 cells; adaxial extensions 1–3-seriate, 2–5 cells deep. Kranz mestome sheath of third-order vascular bundles entire, with 7–10 cells. Kranz cells rounded, with radial and outer tangential wall inflated, longer parallel to the vein in paradermal section; specialized chloroplasts with tendency to show a centrifugal location. *Sclerenchyma:* adaxial and abaxial girders well developed, relatively narrow and deep, always associated with all first-order vascular bundles; sclerenchyma minute, inconspicuous adaxial and abaxial girders associated with all second-order vascular bundles; girders or strand not associated with third-order vascular bundles. Fibers very thick-walled with lumens almost completely filled, lignified. Small sclerenchyma cap in the leaf margin, curved in shape with sclerenchyma extending along abaxial side of the leaf. *Mesophyll:* chlorenchyma irregularly radiate, continuous between vascular bundles, cells small, irregularly shaped, tightly packed without visible intercellular air spaces; 2–3 chlorenchyma cells between contiguous vascular bundles, 95–200 µm between contiguous vascular bundles; colorless cells below the bulliform cells. Fusoid cells absent. Arm cells absent. *Adaxial epidermal cells:* bulliform cells present at the base of all adaxial furrows and occurring in restricted, fan-shaped groups usually with an inflated central cell; bulliform cells up to ⅓ the leaf thickness. Epidermal cells with distinct continuous cuticle; prickle hairs present; macrohairs, microhairs, and papillae absent. *Abaxial epidermal cells:* bullifom cells absent; epidermal cells small with a very thick cuticle; prickle hairs present; macrohairs, microhairs, and papillae absent. *Amiloplast* present in the Kranz cells.

ABAXIAL EPIDERMIS IN SURFACE VIEW, FIGURE 3C

Costal zone: long cells rectangular in outline, more than 3× longer than wide, anticlinal walls

parallel, undulated; long cells separated by cork-silica cell pairs; silica bodies irregularly dumbbell-shaped. Prickles absent. *Intercostal zone:* long cells rectangular in outline, more than 3× longer than wide, anticlinal walls parallel, end walls vertical; long cells separated by single short cells; silica bodies irregular in outline. *Microhairs:* absent. *Stomatal complex:* low triangular, 38–45 μm long, 23–28 μm wide, in 2 rows in the costal zone; one interstomatal cell between successive stomata in a row. *Macrohairs:* present or absent, when present in the leaf margin, cushion base. *Hooks:* present in the middle of the intercostal zone, small with the base shorter than the stomata, barb shorter than the base. *Papillae:* absent.

ADAXIAL EPIDERMIS IN SURFACE VIEW

Costal zone: same as for the abaxial surface, but with conspicuous prickles. *Intercostal zone:* long and short cells identical to those of the abaxial epidermis. *Microhairs:* none seen. *Stomatal complex:* low triangular, arrangement as in the abaxial epidermis. *Macrohairs:* same as for the abaxial epidermis. *Hooks:* frequently in the intercostal zone, small with the base shorter than the stomata; barb developed basally from the apex to the base, longer than the base. *Papillae:* absent.

The epidermal characters of *S. rigidifolia* correspond to the panicoid dermotype (Prat, 1960), with irregular dumbbell-shaped silica bodies, rectangular long-cells with undulating walls and alternating with short cells. An interesting feature that became evident in this study was the absence of bicellular microhairs on both epidermides of *S. rigidifolia*. This is noteworthy since bicellular microhairs are characteristic of subfamily Panicoideae (Ellis, 1977), and they are also present in all the other species of *Streptostachys*. It should, however, be noted that they are also lacking in other panicoid genera such as *Yvesia*, *Oryzidium*, and *Milbradochloa* (Renvoize, 1987).

Streptostachys rigidifolia is, according to the anatomical data presented here, a Kranz species, of the subtype MS, with a single Kranz mestome sheath around the vascular bundles, with centrifugal chloroplasts on the Kranz sheath, cells of the mestome sheath longitudinally elongated in paradermal view, and 2–3 mesophyll cells between contiguous vascular bundles.

According to the correlation encountered in the Kranz syndrome between anatomical and physiological characters (Brown, 1977; Ellis, 1977; Hattersley, 1987; Tregunna et al., 1970), it is concluded that *S. rigidifolia* is a C_4 species of the NADP-me physiological subtype or malate former (Downton, 1970; Gutiérrez et al., 1974).

Streptostachys rigidifolia shares with *S. ramosa* and *S. macrantha* a similar anatomical type, being all C_4, MS species without fusoid cells. *Streptostachys ramosa*, however, has bicellular microhairs, conspicuous papillae on the abaxial epidermis, discoid stomata, four types of vascular bundles, and no colorless cells below the bulliform cells. *Streptostachys macrantha* also has bicellular microhairs, a thinner transverse section and four types of vascular bundles. *Streptostachys asperifolia* differs by being a C_3 species with keel, arm cells, and conspicuous fusoid cells (full anatomical descriptions of the species previously mentioned are given in Morrone & Zuloaga, 1991).

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